



BRIEFER ARTICLES.

THE AECIDIUM OF MAIZE RUST.

THE great economic importance of the corn (maize) crop lends special interest to any discovery relating to the habits and development of corn parasites. It is partly for this reason, and partly because it illustrates a method of observation not yet commonly understood, that the following narrative of the discovery of the aecidium of *Puccinia Sorghi* Schw., the common rust of corn, is given here in advance of the season's culture work, of which it forms a part, and which has been undertaken in cooperation with the Bureau of Plant Industry of the U. S. Department of Agriculture.

As corn rust is practically coextensive in geographical distribution with the cultivation of its host, although rarely so abundant and destructive as to attract the attention of the cultivator, and as no aecidium has seemed even in the remotest way to have connection with it, the view has gained ground that either an aecidium is no longer produced in its life-cycle, or that it occurs only in regions where corn was originally wild. In the latter case the aecidium might inhabit some host of restricted range, for all glumaceous rusts with one exception are heteroecious, and the chances, therefore, to detect and prove the genetic connection would be few. I have found that corn rust continues to produce uredospores until very late in the fall, in fact often as long as the corn plants are alive. On October 9, 1901, I tested uredospores taken from plants in the field partly killed by frost, and found that they germinated well in drop cultures. It would seem possible for the rust in northern regions to be wholly distributed by uredospores, beginning in spring from a locality sufficiently far southward to permit the corn plant to survive the winter. However, all these ruminations have taken on a different aspect by the discovery of the aecidium.

The preliminary observations, which provided the necessary inference on which successful cultures were founded, were essentially of the same character as those connected with three-fourths of the discoveries in heteroecism which I have so far made, and are therefore given in some detail as a typical and suggestive example of the method employed in my work.

On June second of the present year, while walking through a thick growth of weeds bordering a cultivated field, I came upon some plants of *Oxalis cymosa* Small, the common form of yellow wood-sorrel in this region, bear-

ing aecidia. The weeds were over two feet high, mostly *Ambrosia trifida*, with many small plants of other species beneath, the *Oxalis* being abundant. As this aecidium is rarely collected, I began to gather herbarium specimens, and observed that while nearly every leaf on the lower half of the *Oxalis* stems was infected with the rust over an area of about three feet in diameter, beyond that area it grew less frequent, and was quite absent in four or five feet from the center of the infected area, although the *Oxalis* plants were equally abundant everywhere in the vicinity. It seemed to me this gave evidence that the teleutosporic source of infection was within the narrow limits of the rusted area. I reasoned that if the sporidia had been blown from a distance, the infection would have been more evenly distributed, and over a larger area. I observed that the lowest leaves on the plants were most thickly dotted with aecidia, and especially those caught beneath the tangle of dead stems from last year's growth. This indicated that the germinating teleutospores must have lain close to or upon the ground, and that the protecting weeds and shrubs had prevented currents of air from materially distributing the sporidia.

I now instituted a search for remains of sedge or grass which might happily show a few teleutosporic sori. Usually one is embarrassed by finding portions of many species, often unidentifiable, but in this case I could find no clumps or stalks of sedge or grass within the infected area, apparently none having grown the previous season, doubtless prevented by the dense thicket of tall weeds, or else they had wholly disintegrated. There was, however, quite a mass of débris deposited by the spring overflow of the near-by river, made up largely of broken cornstalks, but so covered with silt that it was impossible to tell if they had borne rust or not. The cornstalks did not occur beyond the affected area, and so were seized upon as a possible, although very dubious, clue.

The task of testing this inference was neither difficult nor protracted, a piece of good fortune but rarely encountered. Rusted leaves of the *Oxalis* were taken to the laboratory, about two miles distant, their long petioles placed in a vial of water, and adjusted over a potted plant of corn (*Zea Mays* L.), the whole being covered with a bell jar. On the third day the bell jar was removed.

On the fifth day the corn leaves appeared paler where the spores had presumably fallen; on the seventh day watery pimples began to show; and on the eighth day a few uredosori had opened. In a day or two more hundreds of characteristic sori were displaying a wealth of fuscous spores; and nearly the whole green area of the leaf blades, upon both sides, was so thoroughly rusted as to threaten the life of the tissues.

This prompt and very abundant appearance of the uredo could be interpreted only as the result of the aecidial infection, for corn rust had not yet appeared out of doors, and even if it had, such an unusual attack following closely within the time limit of incubation would be highly improbable. It may therefore be considered proved that the aecidium of *Puccinia Sorghi* Schw. occurs upon *Oxalis*, and a verification with teleutosporic material can be confidently undertaken in due time.

There are but seven or eight records in literature of the collection of aecidia on *Oxalis*, and there is little doubt, if any, that in every case the aecidium belonged to *Puccinia Sorghi*. They are as follows:

1876. Collected on *Oxalis Bowiei* Lindl. near Somerset East, Cape Colony, South Africa, by P. MacOwan, and issued in Thuemen's *Mycotheca universalis*, no. 1226. It was given the name of *Aecidium Oxalidis* by Thuemen and described as a new species in *Flora* 63:425. 1876. I have seen several specimens from this collection, and can detect no morphological difference between the African fungus and the one from which I raised uredospores. The probability of its being the same species is somewhat increased by the fact that *Puccinia Sorghi* Schw. on cultivated corn was also found near Somerset East by the same collector (*Flora* 63:569. 1876) in the preceding autumn.

1877. Collected on *Oxalis violacea* L. at Ames, Iowa, by the writer (*Bull. Iowa Agric. College* —:167. Nov. 1884). Only a few affected leaves were found.

1887. Collected on *Oxalis stricta* L. at Manhattan, Kan., by W. A. Kellerman (*Eliss & Everhart's North Amer. Fungi*, no. 2210) and M. A. Carleton (*Bartholomew's Kansas Uredineae in Trans. Kans. Acad. Sci.* 16:190). These citations probably represent only one collection. The specimen in N. A. F. agrees with the Indiana collection, except that the host is a different though closely related species.

1889. Collected on *Oxalis violacea* L. at Lincoln, Neb., by H. J. Webber (*Bull. Neb. Agric. Exper. Sta.* no. 11:333, and *Rep. Neb. Bd. Agric.* 1889:211), who speaks of it as rare; and also on the same host at Weeping Water, Neb., about 50^{km} from Lincoln, by T. A. Williams (*Rep. Neb., Bd. Agric. l. c.*), who reports it as common. I have not seen these collections.

1893. Collected on *Oxalis corniculata* L. at Bozen in the Austrian Tyrol, by J. Peyritsch. This was published by Dr. P. Magnus in the *Innsbruck Naturw.-Med. Verein reports* for 1894, and described as a new species with the name *Aecidium Peyritschianum*. I have not seen a specimen from this collection, or the published article, but I do not doubt that

the name is a synonym of *Aecidium Oxalidis* Thuem., judging from the brief description in Saccardo's Syll. 11:215, and from the fact that corn is grown in the region where the fungus was found.

1893. Collected on *Oxalis stricta* L. at Lincoln, Neb., by the Botanical Seminar (Bot. Survey Neb. 3:10). I have not seen the collection.

1894, 1899. The herbarium of the writer also contains a collection made by Mr. T. A. Williams on July 13, 1894, at Brookings, S. D., and one by Mr. E. Bartholomew on June 5, 1899, in Rooks county, Kan., both on *Oxalis stricta* L., of which there is no published record.

Summing up the evidence, the writer believes that all the above collections can be placed with much confidence under *Puccinia Sorghi* Schw., as representing the aecidial stage of the fungus. It would be interesting to discuss the change in views which this discovery of the aecidium must produce regarding the propagation and dissemination of corn rust, but that can better be left for another occasion.—J. C. ARTHUR, *Purdue University, Lafayette, Ind.*